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1. Title of Invention

Light-conductive Scattering Panel for A Watch With Liquid Crystal Display

2. Claims

(1) A light-conductive scattering panel for a watch with liquid crystal display wherein the main body of the panel is formed in the shape of a wedge such that the thickness thereof is decreased from one end to the other end, a wave-shaped surface is formed on the front face thereof in which wave crests extend perpendicularly to the direction of incident light, and a reflecting plate is attached or a reflecting surface is directly formed on the rear face thereof so that the light is reflected.

(2) A light-conductive scattering panel for a watch with liquid crystal display wherein the main body of the panel is formed in the shape of a wedge such that the thickness thereof is decreased from one end to the other end, a wave-shaped surface is formed on the front face thereof in which wave crests extend perpendicularly to the direction of incident light, and a metal reflecting plate on the rear face of which is provided with an insulating coating is laminated on the rear face thereof, while the edges of the main body are bent to embrace and fix the metal reflecting plate.

3. Detailed Description of Invention

The present invention relates to a light-conductive scattering panel for a watch with liquid crystal display.

Conventionally, there is one type of a display portion in a watch with liquid crystal display, i.e., a so-called display, which has a night illumination unit as shown Figure 1.

The night illumination unit consists of a light-conductive scattering panel 17 on the underside surface of which a reflecting plate 18 such as aluminum is attached and a lamp 19 mounted on the side of the light-conductive scattering panel. The light-conductive scattering panel 17 is made of transparent glass or synthetic resin, and its upside surface is pear-grained and its underside surface is flat. When the light of the lamp 19 enters through the side thereof, the light is scattered in the whole range thereof, diffused by the pear-grained surface and reflected by the reflecting plate 18 so as to illuminate an upper display member. The thickness of the light-conductive scattering panel 17 is usually about 0.5 mm.

Note that the display member consists of an ornamental plate 13, a polarizing plate 14, a liquid crystal displaying element 15 and a polarizing plate 16 laminated between two upper and lower glass plates 11 and 12.

However, since light is entered from the side into a transparent plate having a constant thickness which has a pear-grained surface on the upside thereof and a reflecting plate 18 attached on the underside thereof in the conventional light-conductive scattering panel 17, all of the incident light cannot always act to the pear-grained surface. Also, only a part of the light once reflected by the pear-grained surface can effectively act to the reflecting plate 18. Additionally, since light is projected from the side direction to the pear-grained surface, the light upwardly directed to illuminate the display member is extremely reduced. Thus, the conventional light-conductive scattering panel 17 has a quite inferior efficiency.

A main object of the present invention is to overcome the above defect of the prior art and greatly to increase the efficiency thereof.

By the way, an attaching method using adhesives is conventionally used in order to attach the reflecting plate 18 on the underside surface of the light-conductive scattering

panel 17.

Also, although not shown in the figure, in order to insulating electrically the rear surface and the side surface of the reflecting plate 18, an insulating sheet of a ⊐-shaped section having standing edges is adhered with adhesives.

However, when the reflecting plate 18 is adhered to the light-conductive scattering panel 17, the reflectivity of the reflecting plate 18 is deteriorated, that is the similar phenomenon to that wherein the light transmittivity of the light-conductive scattering panel 17 is reduced. If insufficiently adhered, spots are produced in the reflected light. Thus, there is caused a defect that the illumination efficiency is inferior.

Further, the above insulating sheet having a ⊐-shaped section is required to be thin from the point of view of its mounting space. Therefore, it cannot be easily molded using synthetic resin, so that there is a defect that the cost of parts is increased.

Still further, since respective one of the reflecting plate 18 and the insulating sheet is adhered by adhesives, there is also a defect that the assembling operation of them is complicated and troublesome and therefore the assembling cost is high.

The present invention also removes the above defects and intends to provide a light-conductive scattering panel with greater efficiency and of a cheaper cost.

Thus, the present invention constructs a light-conductive scattering panel in such a manner that the main body of the panel is formed in the shape of a wedge such that the thickness thereof is decreased from one end to the other end, a wave-shaped surface is formed on the front face thereof in which wave crests extend perpendicularly to the direction of incident light, and a reflecting plate is attached or a reflecting surface is directly formed on the rear face thereof so that the light is reflected.

In the case of using a metal plate as the reflecting plate, an insulating coating is

provided on the rear face of the metal reflecting plate, and the so-provided plate is laminated on the rear face of the main body, while the edges of the main body are bent to embrace and fix the metal reflecting plate.

An embodiment of the present invention shown in Figures 2 through 5 will be explained below.

In Figures 2 and 3, the sign 21 designates a main body. The main body is a plate molded of transparent synthetic resin. The size thereof is about 20 mm in the lateral width, about 10-15 mm in the longitudinal width, about 0.5 mm thick at the edge (a) for light entrance and about 0.25-0.40 mm thick at the other edge (b). The thickness thereof is gradually decreased from the edge (a) for light entrance to the other edge (b).

The front surface (c) of the main body is formed wave-shaped, where a wave crest extends perpendicularly to the direction of incident light. The wave-shaped surface is triangular wave-shaped as shown in Figure 4, where the wave is an isosceles triangular wave which rises at the angle of 45°, descends at the angle of 45° and has a wave crest value of 0.1 mm or so and a wave length of 0.2 mm or so. Note that it has been confirmed by experiments that the wave shape and those numeral values are effective.

The main body 21 has the flat rear surface (d) and drooping edges 22 and 23 at both ends thereof.

The sign 24 designates a metal reflecting plate made of aluminum, on the rear side of which an insulating coating 25 is provided using synthetic resin. The metal reflecting plate 24 is laminated on the rear face of the main body 21 as shown by the process from A to B in Figure 5, and then the drooping edges 22 and 23 of the main body 21 are bent by a heating roller R made of teflon or the like so as to embrace and fix the metal reflecting plate 24 as shown by C in Figure 5.

As the panel is thus constructed, when the light from a lamp P enters into the

thicker edge (a) for light entrance as shown in Figure 3, the light advances in the main body 21. Since the main body 21 is wedge-shaped, almost all of the incident light directly strikes on one side of a wave shape in the surface (c), at which a part thereof goes outward. Since the wave shape has the wave crest extending perpendicularly to the direction of incident light, the light reflected by one side of the wave shape directs toward the metal reflecting plate 24 without being spoiled, thereat is reflected again, and goes outward from the other side of any wave shape. Also thereat, a part of the light is reflected, then is reversed by the metal reflecting plate 24, and goes outward from the one side of any wave shape. As described above, the light is externally emitted with superior efficiency and therefore an upper display can be brightly illuminated without any spot.

Further, since no adhesive is used, there is no deterioration of reflective efficiency of the metal reflecting plate 24 and no spot in the reflection. Since it is necessary to provide the insulating coating only on the rear face of the metal reflecting plate 24, the coating operation is easy. The metal reflecting plate 24 is sufficiently insulated, even on the sides thereof, by the drooping edges 22 and 23 of the main body 21, and the assembling operation is easy and speedy because of no adhering operation, as well as it is unnecessary to use a conventional insulating sheet, therefore it is cheaply manufactured. In addition, even though projections are produced when the metal reflecting plate 24 is chopped, the projections are packed with the drooping edges 22 and 23 of the main body 21, and therefore the degree of insulation is remarkably improved.

Mass production of the panel is easy, so that the present invention is much effective and suitable.

4. Brief Description of Drawings

Figure 1 is a diagram for explaining the principle of a display having a night illumination unit. Figure 2 is a perspective view for showing an embodiment of the present invention. Figure 3 is a sectional view of the embodiment. Figure 4 is a partly enlarged, sectional view of the embodiment. A, B and C in Figure 5 are diagrams for explaining the

manufacturing processes.

21: main body
22, 23: drooping edge
24: metal reflecting plate
25: insulating coating

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㊹液晶表示時計に於ける光導拡散板

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明細書

1. 発明の名称

液晶表示時計に於ける光導拡散板

2. 特許請求の範囲

(1) 主体を入光側の一端から他端へ向け次第に厚みが薄くなる楔状に形成すると共に、その表面に於いて入光方向に直交して波頂の延びる波状面を形成し、またその裏面には反射板を付設するか或いは直接反射面を構成することにより光が反射するようにしたことを特徴とする液晶表示時計に於ける光導拡散板。

(2) 主体を入光側の一端から他端へ向け次第に厚みが薄くなる楔状に形成すると共に、その表面に於いて入光方向に直交して波頂の延びる波状面を形成し、またその裏面には裏面へ絶縁コーテングを施した金属反射板を重合し、主体の頂部を金属反射板に抱接させたことを特徴とする液晶表示時計に於ける光導拡散板。

3. 発明の詳細な説明

本発明は液晶表示時計に於ける光導拡散板に関するものである。

従来、液晶表示時計の表示部所謂デスプレイには、第1図に示すように夜間照明装置付のものがある。

この夜間照明装置は、下面にアルミニウム等の反射板18を備えた光導拡散板17の側面にランプ19を設けたものであり、その光導拡散板17は透明のガラス或いは合成樹脂よりなり、上面が梨地に、下面がフラットの面に構成され、ランプ19の光が側方より入ると、これが全域に分散されてその梨地面で拡散されると共に、反射板18で反射されて、上方の表示体を照す。光導拡散板17の厚さは通常約0.5mmである。

なお、表示体は、第1図に示すように、上下二枚のガラス板11，12間に化粧板13、偏光板14、液晶表示素子15、偏光板16を次々に積層したものである。

しかし、従来の光導拡散板17は均一の厚みの透明板の表面を梨地とし裏面に反射板18を当て状態で側面より光を送り込むために、入射光が全て梨

地面に作用するわけには行かず、また、反射板18が有効に作用するのは裏地面に一旦反射されたものの一部だけとなり、而も、裏地面に対し側方から光がもたらせるために実質的に上方に向つて表示体を照す光は極めて少ない甚だ効率の悪いものであつた。

本発明の主たる目的は斯る従来の欠点を除去しその効率を大巾に向上しようとすることにある。

ところで、従来、光導拡散板17の下面に反射板18を取付けるには、接着剤を用いて貼着する手段が講じられる。

また、反射板18は、図示してないが、表面及び側面を電絶縁する必要から、起立縁を有する断面コ字状の絶縁シートを反射板18に下方より接着剤を以て貼着している。

しかし、反射板18を光導拡散板17に接着すると、反射板18の反射効率が低下し、光導拡散板17に於いて光線の透過率が低下したと同様の現象を生じ、接着不十分の際反射光に斑が生じ、照明効果が悪い欠点がある。

また、上記断面コ字状の絶縁シートは、スペースの関係から薄いことが要求され、合成樹脂成形が容易でなく、部品コストが高くなる欠点がある。

更に、反射板18及び絶縁シートは、接着剤で貼着されるので、これがまた面倒で手数がかかり、組立費用が高い欠点がある。

本発明はこうした欠点をも除去し、より効率の高い安価なものを得ようとするものである。

而して、本発明は主体を入光側の一端から他端へ向け次第に厚みが薄くなる楔状に形成すると共に、その表面に於いて入光方向に直交して波頂の延びる波状面を形成し、その裏面には反射板を付設するか或いは直接反射面を構成することにより光が反射するようにしたものである。

そして、反射板として金属製のものを使用する場合には、該金属反射板の裏面へ絶縁コーテングを施し、これを主体の裏面へ重合し、主体の縁部を金属反射板に抱着させたものである。

以下、第2図乃至第5図に示すその実施例について説明する。

第2図、第3図に於いて21は主体である。

該主体21は透明合成樹脂で成形された板体である。大きさは、横巾約20㎜、縦巾10～15㎜程度、厚み入光端面aで約0.5㎜、その反対端面bで0.25～0.40程度であり、厚みは入光端面aから反対端面bへ向け次第に薄くなる楔状になつている。

主体21の表面cは入光方向に直交して波頂の延びる波状面を形成しており、該波状面は第4図に示すように三角波状であり、角度45°で立上り、45°で立下がる二等辺三角波であり、その波高0.1㎜内外、波長0.2㎜内外である。なお、これらの波形や数値は実験で効果を確認したものである。

また、主体21は裏面dが平らで、両側縁に垂下縁22，23を有している。

24はアルミニウム製金属反射板であり、裏面が合成樹脂により絶縁コーテング25されている。

該金属反射板24は第5図Aから B に示すように主体21の裏面に重合し、次いで、第5図Cに示すようにテフロン製等の加熱ローラHで主体21の両垂下縁22，23を折曲して主体21を金属反射板24に抱着させる。

斯様に構成されているので、第3図に示すように肉厚の入光端面aにランプPの光が入射されると光は主体21内を進むが、主体21が楔状であるから入射した光の大半が直接表面cの波状の一辺に当り、一部が外に出る。この波状は光の入射方向に波頂が直交して延びているからこの波状の一辺で反射される光は無駄なく金属反射板24に向いここで再度反射し波状の他辺より外に出る。また、ここでも一部は反射し、これが金属反射板24で反転して波状の一辺より外に出ると云つた具合に効率良く外部に現われ、斑なく明るく上方の表示体を照明する。

また、接着剤が全く使用されることがないので、金属反射板24による反射効率が低下したり斑反射となることはなく、金属反射板24の絶縁コーテングは裏面だけで良いからコーテング作業は容易であり、主体21の垂下縁22，23によつて金属反射板24は側面も十分に絶縁され、接着作業がないから組立作業は容易迅速であり、従来の絶縁シートが

不要であることと相俟つて安価にでき、而も、金属反射板24の裁断の際にバリを生じても、これが主体21の垂下縁22，23で包み込まれるので絶縁性能は著しく向上する。

量産も容易であり極めて有効適切である。

4.図面の簡単な説明

第1図は夜間図明装置付デスプレイの原理説明図、第2図は本発明の実施例を示す斜視図、第3図はその縦断面図、第4図は要部拡大断面図、第5図A B Cは製造工程説明図である。

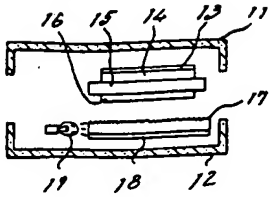
21…主　　体　　22，23…垂 下 縁

24…金属反射板　　25…絶縁コーテング

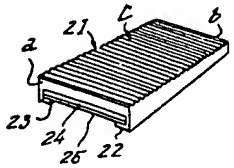
特許出願人　　株式会社　エ　コ　ー

代　理　人　　今　岡　良　夫

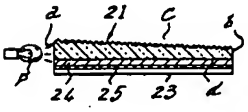
第1図



第2図



第3図



第4図

第5図